Radiochemistry Developments on ^{224}Radium(^{224}Ra)

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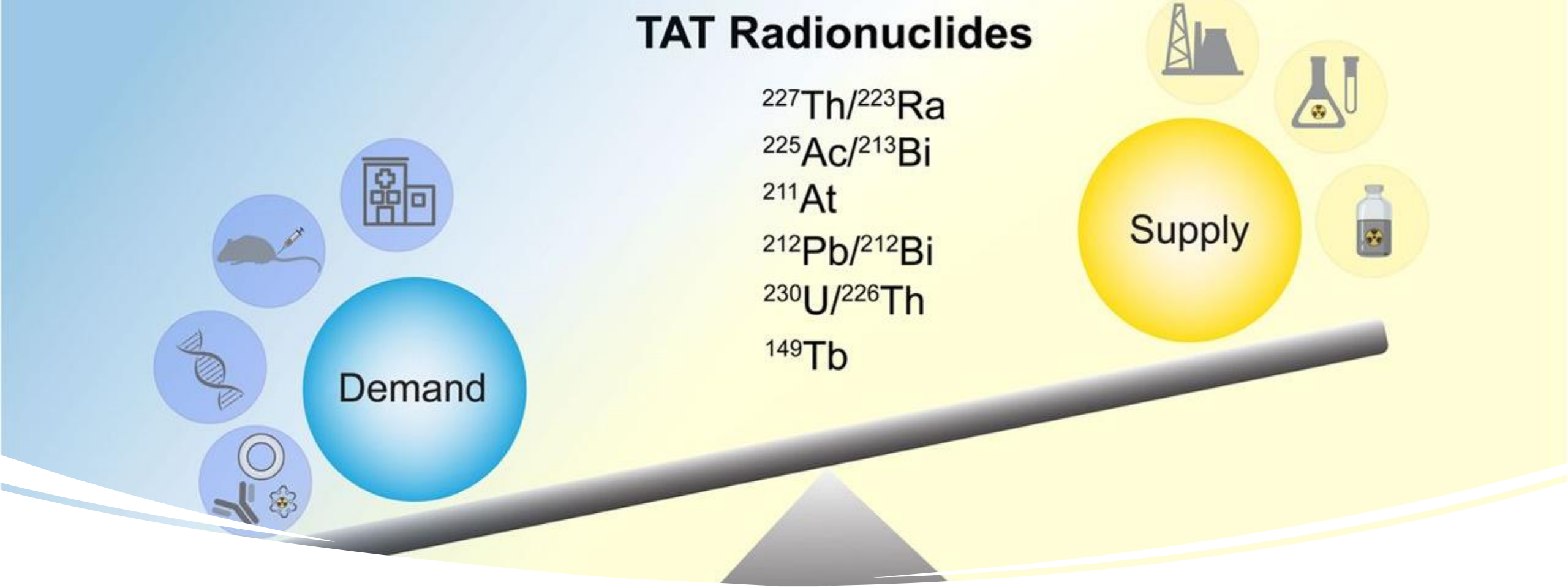
Layout

- Introduction
- Production of ^{224}Radium (^{224}Ra)
- ^{224}Ra/^{212}Pb Generator Production
- Labelling of ^{212}Pb with DOTA
- Conclusion



Introduction

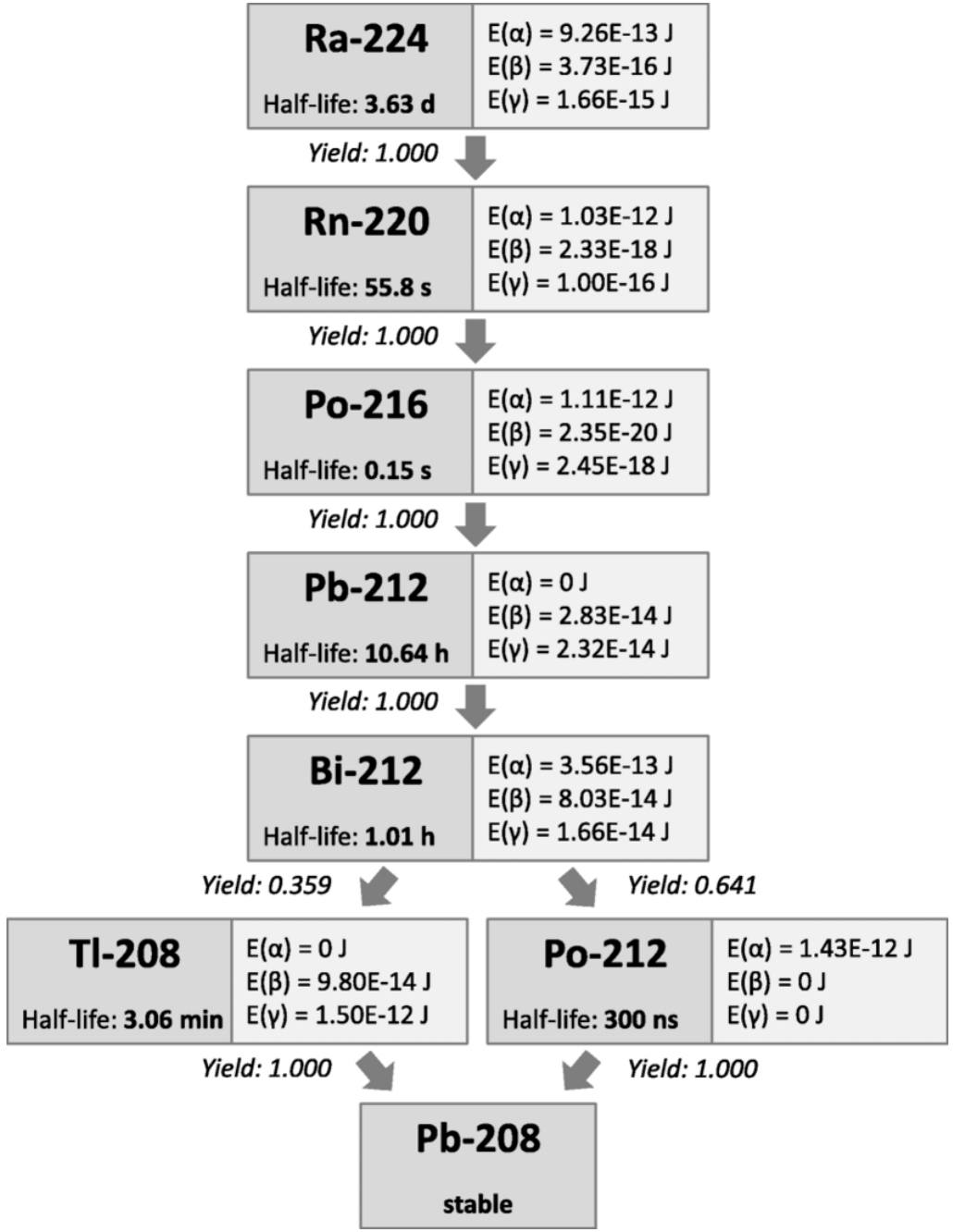
- ^{224}Radium is a pure alpha emitter
- Favorable half life 3.6 day
- Short lived daughter product

Production of ^{224}Radium

- Several method for the production
  - Radiochemical separation from the Th/U
  - Spallation reaction of thorium by proton irradiation
  - ^{228}Th/^{224}Ra Generator

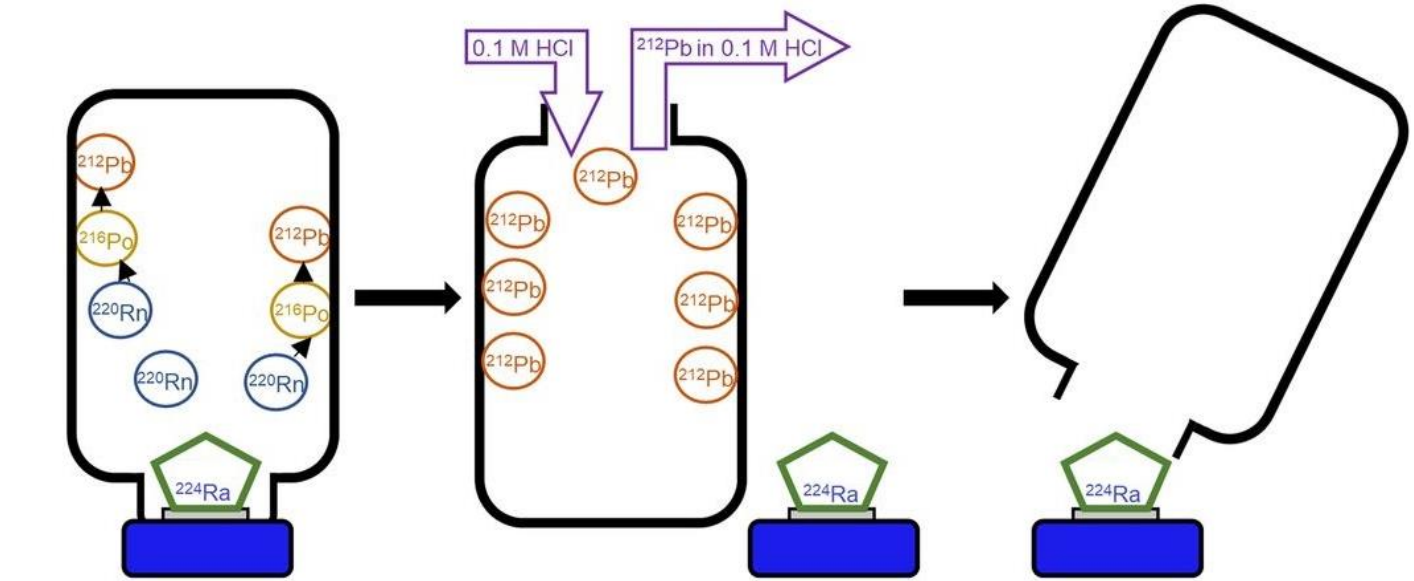
^{224}Radium/^{212} Lead Generator Production

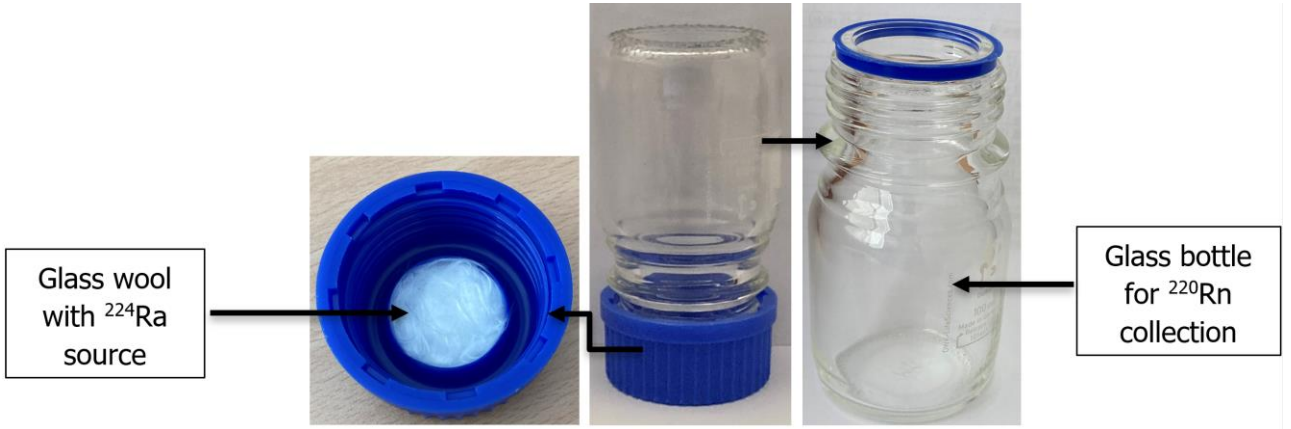
- There are two methods of ^{224}Ra/^{212}Pb generator production
  - Collection of emanated radon from radium source
  - Radiochemical separation of using cation exchange resin.



$^{224}Ra/^{212}Pb$ Generator by Radon Collection

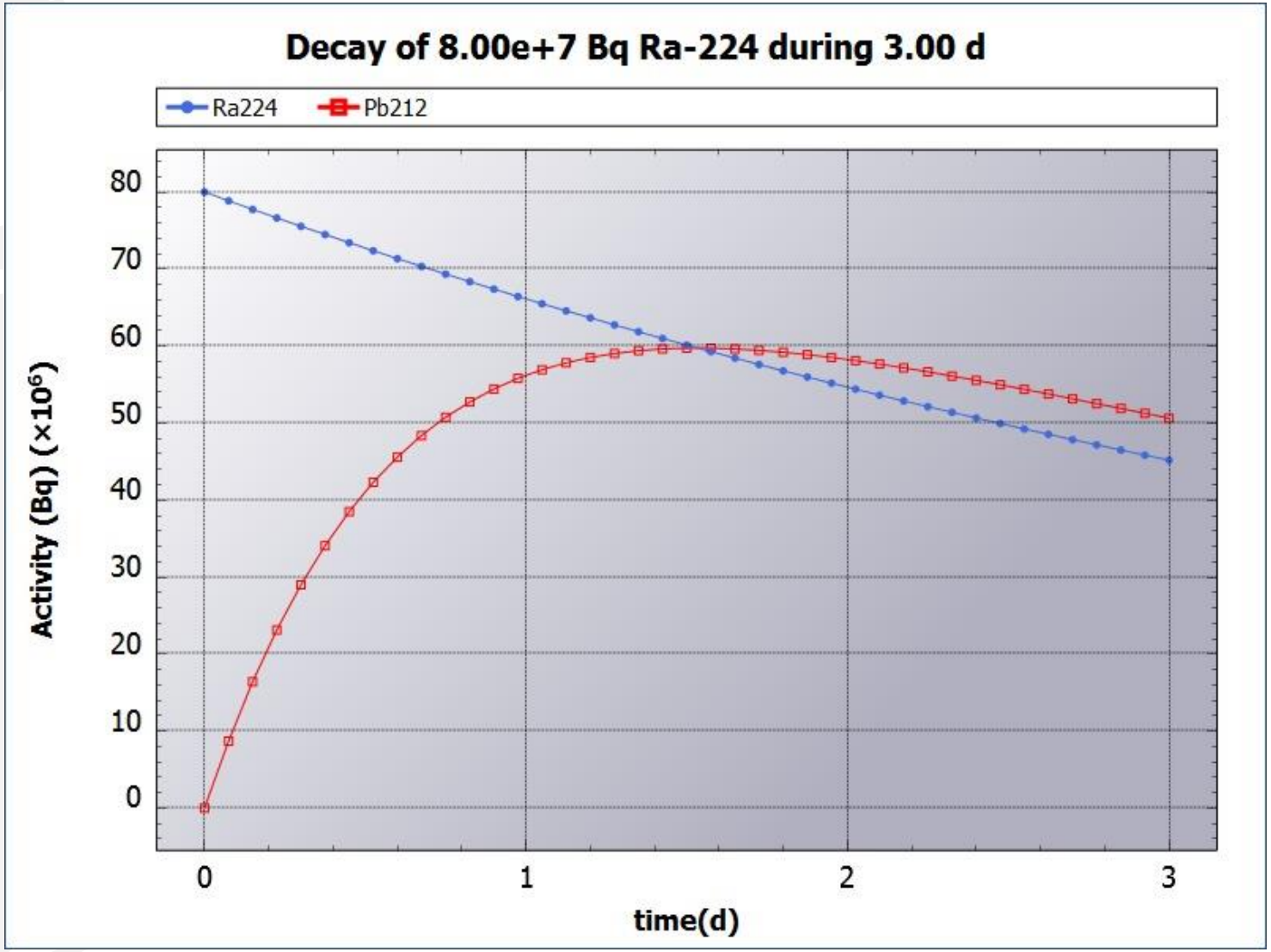
- ^{224}Radium is used as source in the generator
- Glass bottle with plastic lid as generator body
- Source adsorbed on the glass wool
- Collection chamber for radon
- Decays into ^{212}Pb





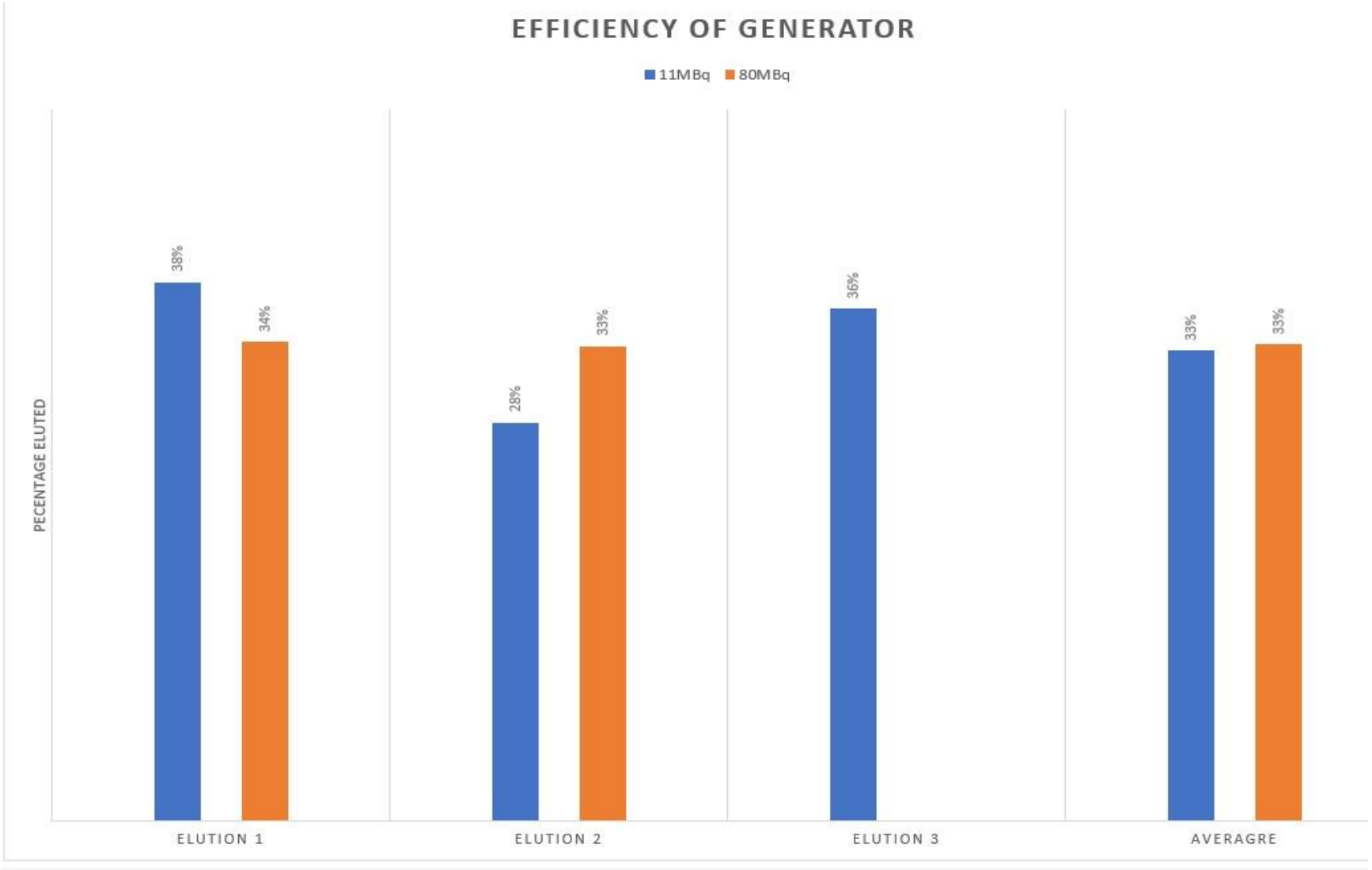
Elution of Generator

- Elution of generator after the establishment of secular equilibrium
- Elution of ^{212}Pb with 0.1M HCl



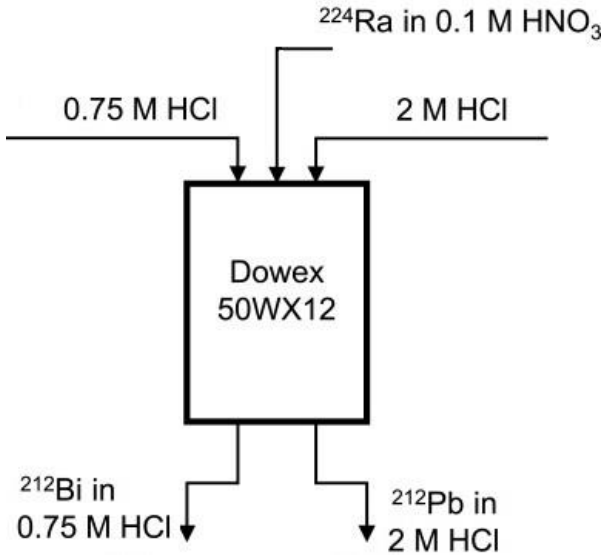
Efficiency and Stability

- Generator from few kBq to 80MBq are produced
- Elution are taken every two days for several weeks
- Generators are eluted with average efficiency of 33%
- High activity did not damage the generator structure



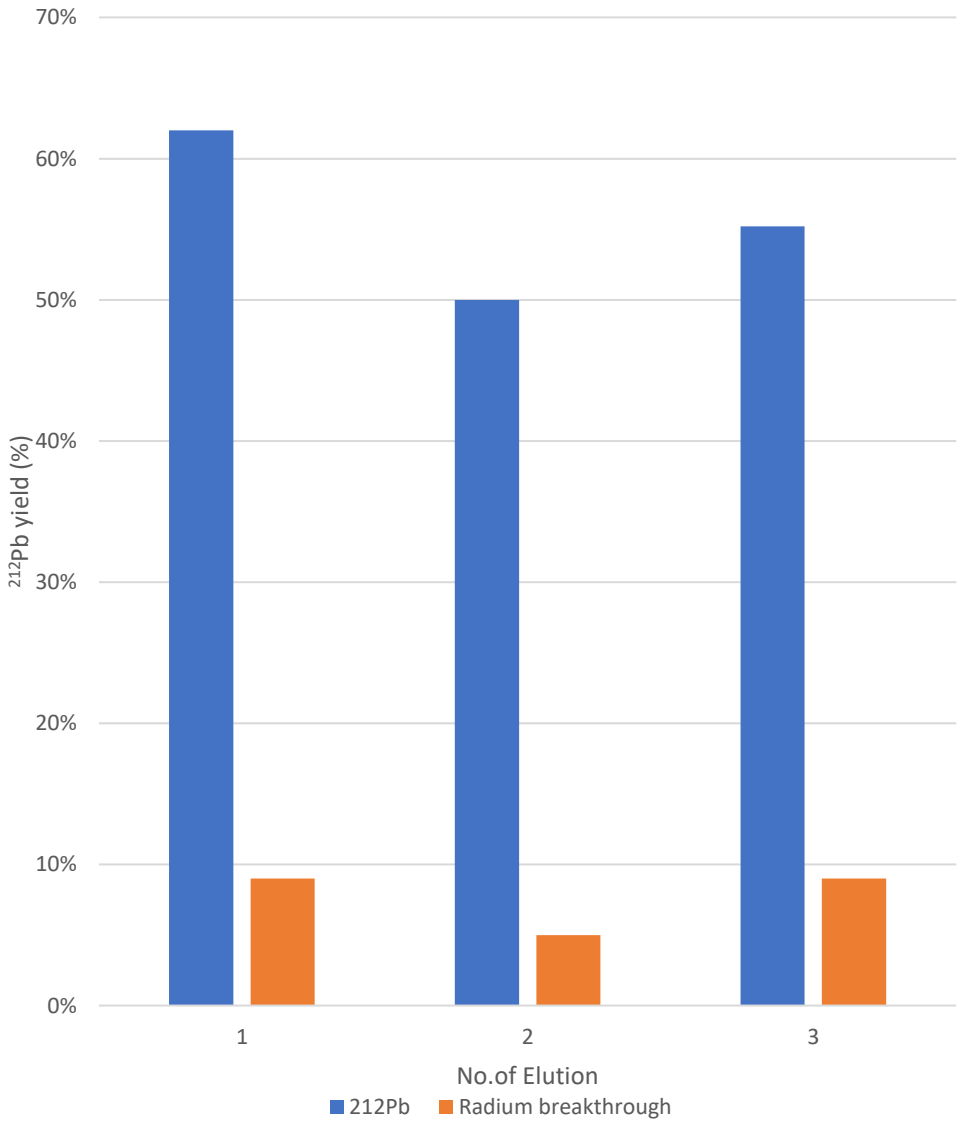
$^{224}Ra/^{212}Pb$ Generator by Cation exchange resin

- Generator consist of a glass column
- Cation exchange resin for adsorption of radium source
- Preconditioning of column
- ^{224}Ra loading on the column followed by washing
- Elution of generator with few ml of HCl



Efficiency of the Generator

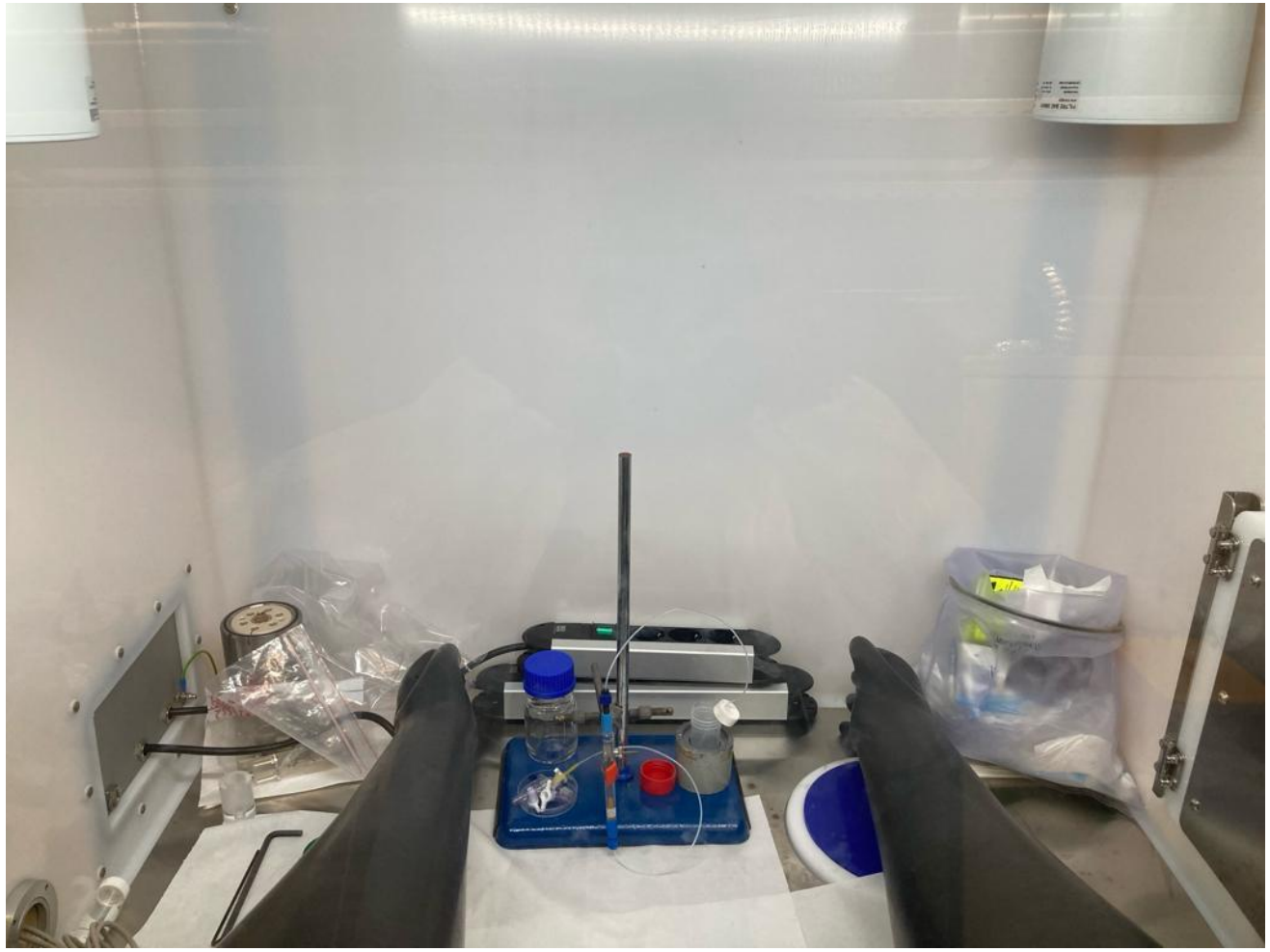
- Generator eluted for three time after every two day
- Average 56% of the ^{212}Pb recovered from the generator
- Ra breakthrough was observed in the elution up to 9%
- Some issues identified during experiment which will lead to improvement



Radiation Safety

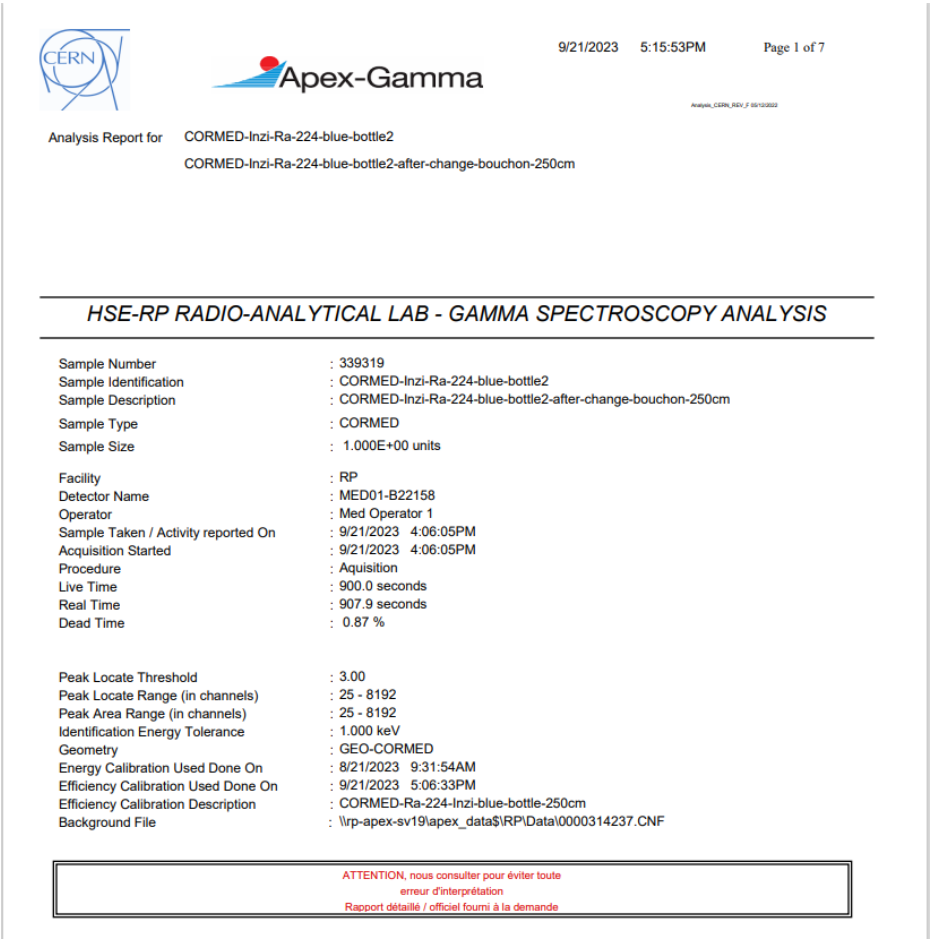
- All the following steps for generators carried out in Gloves box
  - ^{224}Ra foil retrieval for target holder
  - Dissolution of the ^{224}Ra
  - Generator production
  - Elution

  No release of radon or any contamination



Quality of ^{212}Pb from Generator

- Gamma spec. analysis of elution
- In first generator, no radium was detected (<^{224}Ra MDA) in elution
- Generator of activity ~80MBq dispatch to one of partner institute for further evaluation/labelling studies
- In cation exchange resin, up to 9% radium was detected used internally only on experimental work



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Analysis Report for CORMED-Inzi-Ra-224-blue-bottle2
CORMED-Inzi-Ra-224-blue-bottle2-after-change-bouchon-250cm

HSE-RP RADIO-ANALYTICAL LAB - GAMMA SPECTROSCOPY ANALYSIS

Sample Number	: 339319
Sample Identification	: CORMED-Inzi-Ra-224-blue-bottle2
Sample Description	: CORMED-Inzi-Ra-224-blue-bottle2-after-change-bouchon-250cm
Sample Type	: CORMED
Sample Size	: 1.000E+00 units
Facility	: RP
Detector Name	: MED01-B22158
Operator	: Med Operator 1
Sample Taken / Activity reported On	: 9/21/2023 4:06:05PM
Acquisition Started	: 9/21/2023 4:06:05PM
Procedure	: Aquisition
Live Time	: 900.0 seconds
Real Time	: 907.9 seconds
Dead Time	: 0.87 %
Peak Locate Threshold	: 3.00
Peak Locate Range (in channels)	: 25 - 8192
Peak Area Range (in channels)	: 25 - 8192
Identification Energy Tolerance	: 1.000 keV
Geometry	: GEO-CORMED
Energy Calibration Used Done On	: 8/21/2023 9:31:54AM
Efficiency Calibration Used Done On	: 9/21/2023 5:06:33PM
Efficiency Calibration Description	: CORMED-Ra-224-Inzi-blue-bottle-250cm
Background File	: \\rp-apex-sv19\apex_data$\RP\Data\0000314237.CNF

ATTENTION, nous consulter pour éviter toute
erreur d'interprétation
Rapport détaillé / officiel fourni à la demande

Labelling and Further Studies

- Radon collection type generator of 80MBq dispatch to partner institute for further studies
  - Labelling of the ^{212}Pb with DOTATATE
  - Stability of Pb-DOTA Complex in mouse serum
- Request trough PRISMAP for clinical translation studies in Dresden University Hospital

Conclusion

Production of $^{224}Ra/^{212}Pb$ generator of two different types

With generator efficiencies up to 33% and 56%.

High quality product with safe operation

Good labelling result and stability results

Thank you